National Weather Service

Great Falls, Montana

Products & Services Guide

U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
Great Falls, Montana

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weather.gov/greatfalls

Table of Contents

General Public Information

Public Forecasts

The staff at the National Weather Service (NWS) office in Great Falls maintains weather surveillance, forecasting, and warning responsibility for central and southwest Montana. This geographical area is referred to as our County Warning and Forecast Area, CWFA (or CWA) for short. Our office is officially referred to as a Weather Forecast Office, or WFO.

Our primary agency mission is to issue forecasts and warnings to protect life and property, and to promote the welfare and economy of the Nation. We fulfill this mission by issuing various types of forecasts, watches, warnings and advisories to keep you informed and prepared for the weather. We alert you when damaging or potentially life threatening weather occurs or is expected.

Our forecasts are designed to help you plan your day or even your week. These forecasts are continually updated and refined 24 hours a day, seven days a week as new information is received by our highly trained staff of meteorologists and hydro-meteorological technicians.

Our public forecasts are available from the following sources:

- The Great Falls WFO website http://weather.gov/greatfalls
- NOAA Weather Radio broadcasts (ranging from 162.400 Mhz to 162.550 MHz)
- NOAA Weather Wire Service
- EMWIN satellite system
- Private companies which repackage our forecasts

Types of Public Products Issued by WFO Great Falls

Public Zone Forecasts: Public Zone Forecasts include weather information for the next seven days. These forecast include sky condition, wind direction and speed , precipitation and/or obscurations (if occurring or expected), maximum and minimum temperatures, snowfall amounts (if snow is likely), etc. The public zone forecasts are generated and issued at least twice a day and updated as needed. The routine issuance times are 4:30 a.m. and 3:30 p.m. Mountain Time.

The "forecast zones" are areas that represent similar geographic and/or climatological regions. The Great Fall WFO issues public forecasts for 20 zones in north central and southwest Montana (see Figure 1). The names of these zones and the counties or portions of counties they include are listed in Table 1 on the next page. When composing a forecast, two or more zones may be combined into one forecast group if similar weather conditions are expected.

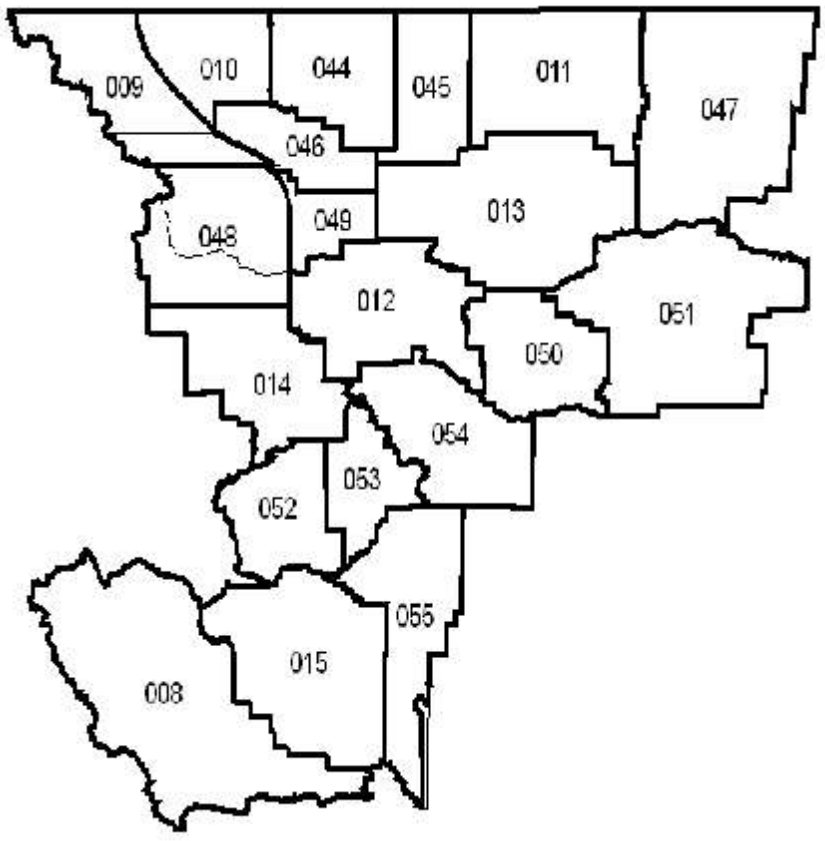


Figure 1. Great Falls WFO Public Weather Zone Forecast Map

Great Falls Weather Forecast Office Public Zones		
Zone Number	Zone Name	Counties Included
8	Beaverhead	Beaverhead
9	Northern Rocky Mountain Front	Western Glacier Western Pondera
10	Eastern Glacier	Eastern Glacier
11	Hill	Hill
12	Cascade	Cascade
13	Chouteau	Chouteau
14	Central and Southern Lewis and Clark	Central and Southern Lewis and Clark
15	Madison	Madison
44	Toole	Toole
45	Liberty	Liberty
46	Eastern Pondera	Eastern Pondera
47	Blaine	Blaine
48	Southern Rocky Mountain Front	Northern Lewis and Clark Western Teton
49	Eastern Teton	Eastern Teton
50	Judith Basin	Judith Basin
51	Fergus	Fergus
52	Jefferson	Jefferson
53	Broadwater	Broadwater
54	Meagher	Meagher
55	Gallatin	Gallatin

Table 1 - Great Fall WFO Public Weather Zones. These zones are shown on the Great Falls County Warning Area zone map on the previous page (Figure 1).

Area Forecast Discussions - GTFAFDTFX: The Area Forecast Discussion provides forecast reasoning, as well as early notification of potential significant weather. There are two routine issuances of our Area Forecast Discussions; by 4:00 a.m. and by 3:00 p.m. Mountain Time. Updated discussions are issued as needed.

Short Term Forecasts - GTFNOWTFX: Weather can change rapidly at times, especially during the summer convective season. During rapidly changing weather events, we issue Short Term Forecasts which serve to keep you informed of weather conditions occurring and expected in your area for up to six hours into the future.

State Forecast Product - GTFSFPMT: The State Forecast Product consists of generalized forecasts out to 5 days in the future for large geographical sections of a state. The Great Falls WFO issues the "CENTRAL AND SOUTHWEST" segment of the State Forecast Product for Montana.

State Forecast - Tabular - GTFSFTTFX, GTSFTMT: A tabular format of the state forecast for specific cities. Includes high and low temperatures, prevailing weather conditions and probability of precipitation through 7 days.

Point Forecast Matrix - GTFPFMTFX: Provides specific values every 3 to 6 hours for a 7 day period. It includes forecast of temperature relative humidity, wind, weather, clouds and precipitation for 8 locations across the Great Falls' CWA.

8 to 14 Day Outlook - GTFEOLMT: A generalized temperature and precipitation outlook for Montana for 8 to 14 days in the future. It provides the trend of above, near or below normal conditions along with the range of normals for the period.

Understanding NWS Forecast Terminology

Forecasts for sky, wind and temperature conditions are an important part of weather information disseminated on a routine basis. Listed below are descriptions of regularly used weather terms that should aid in a better understanding of their meaning.

Sky Condition: Describes the predominant/average sky condition based upon the percentage of the sky covered by clouds.

Sky Condition Expressions	
Cloud Coverage	Sky Condition
0% to 5%	Sunny Clear
6% to 25%	Sunny Mostly Clear
26% to 50%	Mostly Sunny Partly Cloudy
51% to 69%	Partly Sunny Mostly Cloudy
70% to 87%	Mostly Cloudy Considerable Cloudiness
88% to 100%	Cloudy Overcast

Wind: Describes the prevailing direction from which the wind is blowing, with speeds given in miles per hour.

Wind Speed Expressions	
Sustained Wind Speed	Descriptive Term
0-5 mph	Light, light and variable, calm
5-15 mph 10-20 mph	None
15-25 mph	Breezy (mild weather) Brisk (cold weather) Blustery (cold with frequent gusts)
20-30 mph 25-35 mph	Windy
30-40 mph	Very windy
35 to 45 mph	Very windy, Strong winds
40 mph or greater	Strong, dangerous, damaging. High wind warning required.

Temperatures: Describes the forecast maximum and minimum temperature range, or in some cases, the temperature expected at a specific time. Degrees Fahrenheit (°F) are always used in public forecasts.

Temperature Range Expressions	
Temperature Range	Description Examples
48 to 52	Near 50
53 to 57	Around 55
50 to 53	Lower 50's
54 to 56	Mid 50's
57 to 59	Upper 50's
50 to 59	50's

Precipitation Probabilities: Technically, the Probability of Precipitation (PoP) is defined as the likelihood of occurrence (expressed as a percent) of a measurable amount of liquid precipitation (or the water equivalent of frozen precipitation) falling during a specified period of time at any given point in the forecast area. Measurable precipitation is defined as equal to or greater than 0.01 inch. Normally, the period of time is 12 hours, unless specified otherwise.

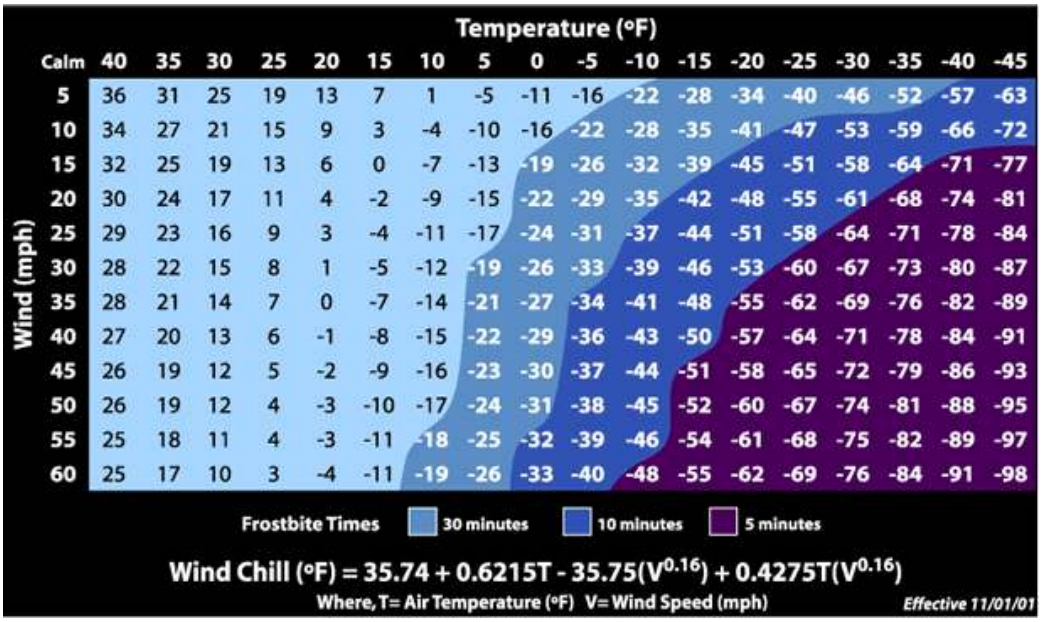
At times, NWS forecasters will use duration qualifiers such as "occasional" or "periods of" to describe a precipitation event that has a high probability of occurrence, though precipitation during that time may not be continuous.

Probability of Precipitation (PoP) Expressions		
PoP Percent	Expressions of Uncertainty	Equivalent Areal Qualifiers
10 percent	Slight Chance or none	Isolated or None
20 percent	Slight Chance	Isolated
30-40-50 percent	Chance	Scattered
60-70 percent	Likely	Numerous
80-90-100 percent (Categorical)	None Used	None Used

Categorical PoP Duration Qualifiers	
Brief	Short; abrupt
Frequent	Persistent short intervals
Occasional	Occurring at irregular or infrequent intervals
Periods of	Series of episodes
Intermittent	Starting and stopping at intervals; not continuous

Wind Chill and Heat Index: The Wind Chill chart shows the cooling effect of wind on human bare skin. Wind of more than 45 mph adds little to the chilling. Wind chills are calculated with sustained wind speeds. Dangerous wind chills begin at -35°F. The Heat Index table shows the combined effect of high temperatures and relative humidity which produce a higher heat index value. Danger begins at 105°F.

NWS Wind Chill Chart



Wind (mph) \ Temperature (°F)	Calm	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
5		36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63
10		34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72
15		32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77
20		30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81
25		29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84
30		28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87
35		28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89
40		27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91
45		26	19	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93
50		26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95
55		25	18	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68	-75	-82	-89	-97
60		25	17	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69	-76	-84	-91	-98

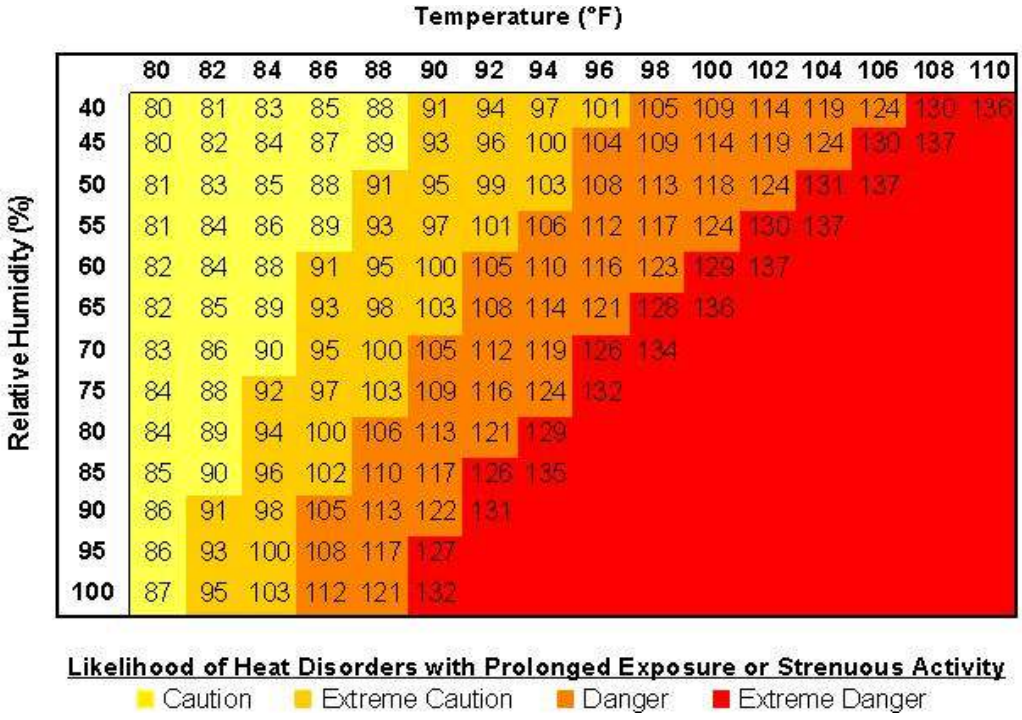
Frostbite Times: 30 minutes | 10 minutes | 5 minutes

$$\text{Wind Chill (°F)} = 35.74 + 0.6215T - 35.75(V^{0.16}) + 0.4275T(V^{0.16})$$

Where, T= Air Temperature (°F) V= Wind Speed (mph)

Effective 11/01/01

NWS Heat Index Chart



Temperature (°F)

Relative Humidity (%) \ Temperature (°F)	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
40	80	81	83	85	88	91	94	97	101	105	109	114	119	124	130	136
45	80	82	84	87	89	93	96	100	104	109	114	119	124	130	137	
50	81	83	85	88	91	95	99	103	108	113	118	124	131	137		
55	81	84	86	89	93	97	101	106	112	117	124	130	137			
60	82	84	88	91	95	100	105	110	116	123	129	137				
65	82	85	89	93	98	103	108	114	121	128	136					
70	83	86	90	95	100	105	112	119	126	134						
75	84	88	92	97	103	109	116	124	132							
80	84	89	94	100	106	113	121	129								
85	85	90	96	102	110	117	126	135								
90	86	91	98	105	113	122	131									
95	86	93	100	108	117	127										
100	87	95	103	112	121	132										

Likelihood of Heat Disorders with Prolonged Exposure or Strenuous Activity

Caution | Extreme Caution | Danger | Extreme Danger

Climatology

Objectives of the Climatology and Data Collection Program

A variety of data collection takes place at the Great Falls WFO, including the surface observation program, the upper-air program and the cooperative observing program. The combination of these various sources comprises, in large part, the input needed to generate computer forecast models, and in the compilation of a climatology database for the United States.

Surface Observing Program: The surface observing program includes the Automated Surface Observing System (ASOS) and manually produced observations.

- ASOS sites record temperature, humidity, wind speed and direction, cloud heights, visibility, pressure, precipitation, present weather and other coded data. Nationwide, there are several hundred of these federally-owned, automated systems. In the Great Falls area of responsibility there are 8 ASOS sites.

ASOS Sites	
LOCATION	SITE ID
Bozeman	BZN
Cut Bank	CTB
Dillon	DLN
Great Falls	GTF
Havre	HVR
Helena	HLN
Lewistown	LWT
Malmstrom AFB	GFA

Two of these sites, Great Falls and Helena, can be augmented with additional weather information via human intervention, as necessary.

Upper-Air Program: Most states have one or two Weather Service offices that are part of the Upper-Air Observing Program, in addition to those of the military. In Montana, Great Falls and Glasgow are responsible for launching these weather balloons twice a day (4 a.m. and 4 p.m. MST). This is performed at the same time worldwide, providing a "snapshot" of the global weather picture.

The data obtained by the radiosondes attached to these balloons are instrumental in creating several computer-generated forecast models. These models are then used by meteorologist in making forecasts. This data collection includes temperature, humidity, wind speed and direction and pressure as the balloon ascends to a average bursting height of 20 miles (100,000 ft).

Cooperative Observing Program: Despite all of the state-of-the-art technology used by the National Weather Service, there remains a program that has remained virtually unchanged since its inception over a century ago. This is the Cooperative Weather Observer Program where 11,700 volunteer weather observers across the country record daily temperature and precipitation data. Some also record or report additional information such as soil temperature, evaporation and wind movement, agricultural data, water equivalent of snow on the ground, river stages, lake levels, atmospheric phenomena, and road hazards. Many cooperative stations in the United States have been collecting weather data at the same location for over 100 years. In Montana, there are nearly 400 cooperative weather stations.

The first extensive network of cooperative stations was established as a result of an 1890 Act of Congress that established the Weather Bureau (although many stations began gathering data long before that time). John Companius Holm's weather records, taken without the benefit of instruments in 1644 and 1645, were the earliest known observations in the United States. Subsequently, many persons, including George Washington, Thomas Jefferson, and Benjamin Franklin maintained weather records. Jefferson maintained an almost unbroken record of weather observations for 40 years, and Washington took his last weather observation just a few days before his death. Because of its many decades of relatively stable operation, high station density, and high proportion of rural locations, the Cooperative Network has been recognized as the most definitive source of information on U.S. climate trends for temperature and precipitation. Cooperative stations form the core of the U.S. Historical Climate Network (HCN) and the U.S. Reference Climate Network (RCN).

In Montana, Lewis and Clark recorded observations as they crossed the state. Additionally, several fur trading posts took sporadic weather observations in Montana from 1807-1861. Nearly continuous weather observations began at Fort Benton in 1862.

Equipment to gather these data is provided and maintained by the National Weather Service. Data forms are sent monthly to the National Climatic Data Center (NCDC) in Asheville, North Carolina, where information is digitized, quality controlled and archived. Volunteer weather observers regularly and conscientiously contribute their time so that their observations can provide vital weather and climate information. This data is invaluable in learning more about the floods, droughts, and heat and cold waves which inevitably affect everyone. The data is also used in agricultural planning and assessment, engineering, environmental-impact assessment, utilities planning, and litigation. Finally, the data plays a critical role in efforts to recognize and evaluate the extent of human impacts on climate from local to global scales.

Climatology Program: Surface weather observations not only serve aviation and public interests in real time, but also provide the raw data used in compiling climatological records for a given area. Montana ASOS observations are archived at the National Climate Data Center (NCDC) where the certified monthly and annual summaries are regularly produced and distributed. Annual summaries incorporate data compiled over a 30 year period in order to derive averages. Current averages are based on the period 1970-2000.

Types of Climatology Products Issued by WFO Great Falls

Locally, the following climatological products are issued by the Great Falls WFO routinely, or as needed.

Daily Climatic Summary - GTFCLIBZN, GTFCLICTB, GTFCLIDLN, and GTFCLILWT: Issued once daily.

GTFCLIGTF, GTFCLIHVR, and GTFCLIHLN: Issued twice each day. The early morning issuance is a comprehensive summary of the previous day's weather conditions while the evening summary is a shorter and preliminary version of the current day.

Monthly Climatic Summary - GTFCLMGTF, GTFCLMHVR, GTFCLMHLN: Issued on the first of each month providing brief narrative of the previous month as well as a statistical look at the averages and extremes. This is a first look at the same data that will be used by NCDC in producing the certified monthly summary.

Record Event Report - GTFRERTFX: A brief report, disseminated as needed, whenever a record phenomenon, usually high or low temperature, precipitation, or wind, etc. has been reached or exceeded.

Regional Weather Roundup - GTFRWRMT: Issued near the top of each hour, listing current weather conditions for the major cities and towns of Montana and surrounding areas.

Regional Temperature and Precipitation - GTFRTPMT: A collective report issued twice daily, primarily around 5:30 a.m./p.m. and 9:30 a.m./p.m. Mountain Time listing high and low temperatures, precipitation, snowfall and snow depth for selected cities and towns. This product also incorporates several "second order" reports gathered from spotters and cooperative observers across Montana.

Severe Weather Watches and Warnings

Objectives of the Severe Weather Program

The protection of life and property is the highest priority of the National Weather Service. The Great Falls WFO issues watches, warnings and advisories for 18 counties in north central and southwest Montana.

Warm Season Warning Program

Warm Season Watches: The NWS issues watches in advance of potentially hazardous weather, with the intent of providing adequate time for people to protect themselves and their property. A watch means conditions are favorable for certain weather phenomena to occur, though the specific occurrence, timing, and location are uncertain. In a watch situation, people should go about their normal activities, but be prepared to take protective action if necessary. Watches include "calls to action" which provide advice to the public on protecting themselves and their property. The following list contains the "watch" categories used by the NWS, primarily during the warm season.

Severe Thunderstorm Watch - GTFWCNTFX: Conditions are favorable for the development of thunderstorm wind ≥ 58 mph and/or hail ≥ ¾ inch in diameter.

Tornado Watch - GTFWCNTFX: Conditions are favorable for the development of tornadoes.

Flash Flood Watch - GTFFFATFX: Potential for rapidly forming, intense flooding resulting from torrential rain, dam breaks or ice jams.

Flood Watch - GTFFFATFX: Potential for longer, more gradual flooding usually beginning after extensive rainfall and/or snowmelt.

Warm Season Warnings: When a warm season warning is issued, it means that certain weather phenomena are occurring or imminent. Warnings also include "calls to action". Warnings issued for events which occur and dissipate within a 6-hour period are known as "short-fused" warnings. Below is a list of warning products issued by the NWS during the warm season.

Severe Thunderstorm Warning - GTFSVRTFX: Thunderstorm wind ≥ 58 mph and/or hail ≥ ¾ inch in diameter are occurring or imminent .

Tornado Warning - GTFTORTFX: Tornado is occurring or imminent.

Flash Flood Warning - GTFFFWTFX: Rapidly forming, intense flooding resulting from torrential rain, dam breaks or ice jams is occurring or imminent.

Flood Warning - GTFFLWTFX: Long duration (more than 6 hours) event, more gradual flooding usually due to rapid snowmelt and/or excessive rainfall along established waterways.

Warm Season Advisories: The NWS issues weather advisories to inform people of events that can result in significant inconvenience and potential damage to property. Advisories include a "call-to-action". During the warm season, the advisories are usually limited to the following:

Urban and/or Small Stream Flood Advisory - GTFFFSTFX: Localized flooding resulting from torrential rain in city areas or on smaller, ungauged streams Flooding not expected to be life-threatening.

Warm Season Statements: The NWS uses a variety of statements to address situations which are not covered by the initial watch, warning or advisory issuances. Among other things, these statements are intended to keep the public informed of on-going severe weather and expected significant weather events. A description of warm season statements is listed below.

Severe Weather - GTFSVSTFX: During a valid severe thunderstorm warning or tornado warning, a *Severe Weather Statement* is issued for the following reasons:

- As an interim statement to provide an update of information to the warning
- To cancel all or part of the warning
- To expire the warning.

Flash Flood Statement - GTFFFSTFX: During a valid flash flood warning, a *Flash Flood Statement* is issued for the following reasons:

- As an interim statement to provide an update of information to the flash flood warning
- To cancel all or part of the warning
- To expire the warning.

Flood Statement - GTFFLSTFX: During a valid Flood Watch or Warning, a Flood Statement is issued for the following reasons:

- As an interim statement when a flood watch or warning is in effect.
- To cancel all or part of a flood warning.
- To extend a flood watch.

Local Storm Report - GTFLSRTFX: Documents reports of severe weather and damage caused by events such as tornadoes, waterspouts, large hail, thunderstorm wind gusts and flash floods. Can also be issued for other weather events and damage at forecaster discretion. Report is issued as close to real time as possible, and as a summary at the end of the event.

Short Term Forecast - GTFNOWTFX: Provides detailed weather information during significant and/or rapidly change weather conditions. Will address the present situation and forecast trend up to 6 hours, usually for situations which have not yet reached severe criteria.

Flood Potential Outlook - GTFESFTFX: Issued to address longer term hydrologic concerns:

- When forecasts project the possibility of flooding more than 24 hours in the future
- To discuss the water supply outlook and spring snow runoff flood potential (issued monthly, January through May)
- To provide information on dry conditions or drought.

Hazardous Weather Outlook - GTFHWOTFX: An event-driven (i.e. issued as necessary), non-technical discussion of specific weather hazards of concern for the first and second forecast periods and the potential for any weather hazards days two through seven of the forecast period. Usually issued in the morning.

Special Weather Statement - GTFSPSTFX: Provides information concerning ongoing or imminent weather hazards that are below warning or advisory criteria. Also issued to report funnel clouds which are not expected to touch ground and become tornadoes.

Watch and Warning Dissemination

Efficient communications are critical during warning situations, and extremely critical when short-fused warnings are issued. There are a number of ways that warnings can be transmitted and received.

NOAA Weather Radio All Hazards: As NOAA Weather Radio (NWR) broadcasts continuously, it is a primary means for automatically alerting and warning the public of impending danger. This is accomplished through the use of special weather band receivers with alert capability. When the NWS activates a 1050MHz signal, the weather radios are activated and emit a noticeable tone alert, followed by an immediate message of the warning.

In addition to automatically providing weather warnings, NWR has the capability of being an "ALL HAZARDS" radio network. When agreements are enacted with state officials, civil emergency messages can be transmitted on NWR in the same manner as life-threatening weather warnings.

Additional information on NOAA Weather Radio All Hazards is available on the Internet at: http://weather.gov/nwr/

NOAA Weather Radios Serving North Central and Southwest Montana		
Location	Call Sign	Frequency
Bozeman, MT	KGG-97	162.500 MHz
Browning, MT	WNG-533	162.525 MHz
Butte, MT	WXL-79	162.550 MHz
Conrad, MT	WWG-84	162.500 MHz
Dillon, MT	WNG-638	162.475 MHz
Great Falls, MT	WXJ-43	162.550 MHz
Havre, MT	WXL-53	162.400 MHz
Helena, MT	WXK-66	162.400 MHz
Lewistown, MT	KZZ-54	162.500 MHz
Malta, MT	WWG-85	162.475 MHz
Winnett, MT	WNG-670	162.400 MHz

For more information on weather radio reception in north central and southwest Montana, please turn to the NOAA Weather Radio All Hazards section of this media guide or check the Great Falls NWS web site at: http://weather.gov/greatfalls

Emergency Alert System - EAS: The Emergency Alert System is designed to maximize the efficiency of warning message transmission through the public airwaves. According to FCC regulations, EAS broadcast systems are located at radio and TV station throughout the United States. In essence, radio and TV stations work jointly with the emergency management service providers, including the NWS, to broadcast life-threatening warnings.

Approximately 85 percent of all EAS activations nationwide have been for weather warnings. The remainder of EAS activations have been for civil emergencies, such as toxic chemical releases. In areas where NWR broadcasts are received, local radio and TV stations (including cable TV) use the NWR broadcast as an EAS source. Other sources for EAS warning activations include local emergency management, law enforcement, and military facilities.

More information on the EAS system is available on the FCC web site at: http://www.fcc.gov/eb/eas

Weather and Storm Spotters

Doppler Radar and other new technologies have significantly enhanced the ability to detect severe weather. However, the ability to determine the actual weather occurring at ground level is still somewhat limited. To fill in this gap, the NWS relies on a network of volunteer weather spotters to report weather information by phone or amateur radio. Reports of events which are not critically time-dependent are also sent to the Great Falls NWS office by e-mail.

In north central and southwest Montana, this storm spotter network has evolved over the past several years to include about 800 volunteers. The benefits of weather/storm spotters in our communities include more detailed and timely warnings, as well as more accurate daily forecasts. However, many areas of north central and southwest Montana remain without any weather spotters.

There are certain weather elements spotters report which help the NWS determine storm severity. These items include wind speed, hail size, snowfall amounts, damage from wind, heavy rains, flooding, etc. A list of suggested items to report is found below.

If you would like more information on how you can take part in protecting lives and property in your community, or know of individuals in any location who would like to assist us, please contact the NWS office in Great Falls. The names and numbers of our weather/storm spotters are kept confidential.

Reporting Severe Weather: To Report Severe Weather, call the Great Falls National Weather Service at 406-453-2081.

Please report the following if you observe them:

- Tornadoes (location & movement)
- Damaging wind (see below)
- Low visibility (blowing dust/snow)
- Dense fog (less than 1/4 mile visibility)
- Weather related damage
- Extreme road hazards from weather
- Frequent cloud to ground lightning
- Rainfall amounts (over 1" in an hour)
- Flooding (location & type)
- Hail (see below)
- Heavy snow (1" or more per hour/ storm total accumulations)
- Freezing rain

Suggested reporting style. Please provide the following:

Who are you:	Identify yourself: John Q. Spotter
What you have seen:	Heavy snow has fallen and is still falling. Total depth of new snow is now 5 inches.
Where you saw it:	8 miles north of Great Falls
When you saw it:	Snow falling at a rate of 1 inch an hour since 2p.m.

Estimating Wind Speed Beaufort Scale	
25-31 mph	Large branches moving, whistling head in wires
32-38 mph	Whole trees moving, resistance felt walking against wind
39-46 mph	Twigs break off trees, impedes progress
47-54 mph	Slight structural damage
55-63 mph	Trees uprooted, considerable structural damage
> 63 mph	Heavy tree and structural damage

Hail Sizes	
Penny	¾ inch
Quarter	1 inch
Golfball	1 ¾ inches
Tennis Ball	2 ½ inches

Damage Assessment

The NWS collects data related to weather that has caused injures, deaths, damage to property or hazardous conditions. This information is tabulated from every NWS office and placed in a monthly publication called “Storm Data and Unusual Weather Phenomena.” The storm data can be purchased through the National Climatic Data Center at http://www5.ncdc.noaa.gov/pubs/publications.html

The Great Falls WFO relies on various sources for inclusion into this document, including county emergency managers, television meteorologists, television/radio journalists, newspapers, county sheriffs, Montana Highway Patrol, Department of Transportation, spotter reports, amateur radio groups and the general public.

We conduct formal Storm Damage Surveys of significant weather events. Certain weather elements we examine include damaging wind, large hail, tornadoes and floods.

Hydrology

Objectives of the Hydrology Program

The objectives of the National Weather Service hydrology program are to:

- Mitigate the loss of life and property by providing the Nation with timely flood warnings and forecasts;
- Support the national economy with water resources forecast services;
- Conduct the necessary research to implement and improve these warnings and forecasts; and
- Provide hydrometeorological data for broad applications to the flood warning and forecast program, water resources planning, and flood plain management programs.

Types of Floods

Flash Flood: A short-term event which requires immediate action to protect lives and property. Flash floods are often caused by heavy or excessive rainfall in a short period of time, and generally occur less than 6 hours from the start of the rainfall. A flash flood can also be caused by dam failure, depending on the type of dam and time period during which the failure occurs, or by the sudden release of water impounded by an ice jam.

Flood: The inundation of a normally dry area caused by an increased water level in an *established* watercourse, such as a river, stream or drainage ditch. In the western U.S., flooding is usually associated with mountain snowmelt, heavy rain falling on melting snow, or high water releases from dams and reservoirs.

Urban and/or Small Stream Flood: Flooding of small streams, streets and low-lying areas (such as railroad underpasses and urban storm drains). This type of flooding is mainly an *inconvenience* and is generally not life-threatening, nor is it significantly damaging to property.

Types of Hydrology Products Issued by WFO Great Falls

Flood Potential Outlook - GTFESFTFX: Issued if forecast meteorological conditions indicate that a significantly heavy precipitation and/or snowmelt episode may occur that would either cause flooding or aggravate existing flooding. Generally issued for time frames greater than 24 hours in the future. Additionally issued to discuss the water supply outlook (issued monthly, January through May), the spring snow runoff flood potential, dry conditions or drought.

Flood/Flash Flood Watch - GTFFFATFX: Issued to inform the public and cooperating agencies that current and developing conditions are such that there is a possibility of flooding, typically within a 6 to 48 hour time frame before the event, but the occurrence is neither certain nor imminent.

Flash Flood Warning - GTFFFWTFX: Issued to inform the public that flash flooding is imminent or in progress, and immediate action is necessary to protect lives and property.

Flash Flood Statement - GTFFFSTFX: Issued during a valid flash flood warning for the following reasons:

- As an interim statement to provide an update of information to the flash flood warning
- To cancel the warning for those areas where flash flooding is no longer a threat.
- To terminate the original warning when it is no longer valid.

Flood Warning - GTFFLWTFX: Issued to inform the public of any high flow, overflow or inundation along a stream or river that is imminent or in progress.

Flood Statement - GTFFLSTFX: During a valid flood warning, a *Flood Statement* is issued for the following reasons:

- To convey supplemental information on previously a issued flood warning, such as updated observations and impact information
- To cancel the warning for those areas where flooding is no longer a threat.
- To terminate the original warning when it is no longer valid.

Urban and Small Stream Advisory - GTFFLSTFX: Issued to address elevated river or stream flows, or ponding of water in urban or other areas, when such events warrant notification of the public in a product less urgent than a warning. Typically for non life-threatening flooding of small streams, streets, parking lots and low-lying areas.

River Statement - GTFRVSTFX: Issued to describe notable hydrologic events that do not warrant a flood warning or statement. Such events could include ice jams, ice movements, low flows, etc.

Advanced Hydrologic Prediction Services

Advanced Hydrologic Prediction Services, AHPS, are a new and essential component of the NWS Climate, Water, and Weather Services. AHPS is a web-based suite of information-rich forecast products. They display the magnitude and uncertainty of occurrence of floods or droughts, from hours to days and months, in advance. These graphical products are useful information and planning tools, and will enable users to make more informed decisions about risk based policies and actions to mitigate the dangers posed by floods and droughts.

The current group of AHPS products covers forecast periods ranging from hours to months. It also includes valuable information about the chances of flood or drought. The information, such as the flood forecast level to which a river will rise and when it is likely to reach its peak or crest, is shown through hydrographs. Other information includes:

- The chance or probability of a river exceeding minor, moderate, or major flooding
- The chance of a river exceeding certain level, volume, and flow of water at specific points on the river during 90 day periods
- A map of areas surrounding the forecast point that provides information about major roads, railways, landmarks, etc. likely to be flooded, the levels of past floods, etc

An additional feature of the AHPS Web site is a map of the river basin and various points along the river for which information is available. The data are not limited to information about floods, but can also provide information about potential droughts. This core suite may change over time reflecting the changing needs communicated by customers.

Additional information on AHPS may be obtained on line at http://www.nws.noaa.gov/oh/ahps.

Some Common Hydrology Terms

Action Stage - Stage which, when reached by a rising stream, represents the level where the NWS or a customer/partner needs to take some type of mitigation action in preparation for possible significant hydrologic activity.

AHPS - Advanced Hydrologic Prediction Services

Bankfull - An established river stage/elevation at a given location along a river which is intended to represent the maximum safe water level that will not overflow the river banks or cause any significant damage within the river reach.

Basin - Whole geographic area having a common outlet (such as a river, stream, or lake) for its surface runoff. Also known as *drainage area* or *watershed*.

Crest - The highest stage or level of water at a specific point before the water begins to recede.

Flood Frequency - The chances that a particular flood event will occur during any given year. The greater the flood, the higher the "Year Flood" Value, but the less chance of occurrence. (i.e. a "100 Year Flood" has a 1% chance of occurring each year; a “2 Year Flood” has a 50% chance of occurring each year).

Flood Stage - The elevation at which overflow of the natural banks of a waterway begins to cause damage or presents a flood-damage hazard near the gage where the elevation is measured.

Flow - The volume of water that passes through a point of a river during a given time. Usually expressed in cubic feet per second (cfs).

Hydrograph - A graph showing stage, discharge, or other property of a river with respect to time.

Ice Jam - A stationary accumulation of ice that restricts or blocks streamflow. Can result from freezing of the stream/river, or from the accumulation of ice chunks during breakup

Reach - The length of area between two specific points along a river, stream, or channel for which river gage measurements are representative.

Runoff - The part of precipitation that flows toward a river or stream on the surface of the ground, or through the soil before returning to the surface.

Stage - The level of the surface of a river or lake above a predetermined base elevation (or "*datum*"). Stage is not representative of the actual depth of the water.

Water Year - October 1 through September 30.

Winter Weather 

Objectives of the Winter Weather Program

Of major importance to the public of north central and southwest Montana is the timing and impact of winter weather phenomena. The National Weather Service uses the terms watch, warning, and advisory to advise the public of the impending hazard, otherwise known as the multi-tier approach. Warnings and advisories will be issued when significant winter weather is occurring, is imminent, or has a very high probability of occurrence. A watch will be used when conditions are favorable for significant winter weather, but uncertainty exists regarding the occurrence, location, and/or timing of the event. The Great Falls WFO issues winter weather products under the header GTFWSWTFX.

The WSW is used to do one, or a combination, of the following:

- Issue the initial winter weather watch, warning, or advisory
- Change the type of watch, warning, or advisory
- Add or delete zones contained within the watch, warning, or advisory
- Change the expiration time of the watch, warning, or advisory
- Update information regarding the watch, warning, or advisory
- Cancel a winter weather watch, warning, or advisory.

The WSW provides a general information and overview section which briefly describes the upcoming winter weather event. This section will typically contain the call-to-action statement. Following this portion of the WSW are the specific zone groups. The zone groups will provide more detail as to the expected impact within that region. These zone groups will always be listed in the following order of priority:

1. Cancellations
2. Warnings
3. Advisories
4. Watches

The expiration time of the WSW product will usually range from 6 to 12 hours following its issuance; however, this time will not necessarily coincide with the expiration time of the watch, warning, or advisory. The Great Falls WFO will update the WSW before or around the time of product expiration.

Types of Winter Weather Products Issued by WFO Great Falls

Before exploring the definitions of the WSW products issued by the Great Falls WFO, let's examine the snowfall criteria for the various locations within the County Warning Area of responsibility.

Snow Event	Below 6000'	Above 6000'
Heavy Snow	≥ 6 inches in 12 hours ≥ 8 inches in 24 hours	≥ 8 inches in 12 hours ≥ 12 inches in 24 hours
Snow Advisory	2-5 inches in 12 hours 1 inch for first event of season	Not issued or Issued at forecaster discretion

A snow event is typically defined as lasting less than 24 hours; however, forecaster discretion will be used for determining when one event stops and another begins.

For locations within the WFO Great Falls forecast area the WSW product will be issued for the following: Winter Storm Watch, Winter Storm Warning, Blizzard Warning, Heavy Snow Warning, Snow Advisory, and Blowing Snow Advisory. The appropriate WSW is issued in accordance with the following criteria:

Winter Storm/Blizzard Watch - GTFWSWTFX: Conditions are favorable for hazardous winter weather or blizzard conditions to develop over part or all of the forecast area, but the occurrence, location, and/or timing is still uncertain. The watch will usually be issued 12 to 36 hours in advance of the event, otherwise described as the 2nd and 3rd periods of the forecast.

Winter Storm Warning - GTFWSWTFX: Winter weather event having more than one predominant hazard (i.e. heavy snow and blowing snow, snow and ice, snow and sleet, etc.) meeting or exceeding warning criteria.

Blizzard Warning - GTFWSWTFX: Snow and/or blowing snow reducing prevailing visibility to 1/4 mile or less, *and* sustained wind or frequent gusts of 35 mph or faster for 3 hours or more.

Heavy Snow Warning - GTFWSWTFX: Heavy snow is expected in accordance with the criteria and locations defined above.

Snow Advisory - GTFWSWTFX: Snowfall is expected to be of significance to pose a hazard and/or inconvenience to the public, but amounts will remain below heavy snow criteria.

Blowing Snow Advisory - GTFWSWTFX: Snow and wind combine to create a significant inconvenience, but snowfall amounts are expected to remain below heavy snow criteria.

Wind Chill Watch - GTFWSWTFX: Conditions are favorable for hazardous wind chill conditions to develop, but the occurrence, location, and/or timing is still uncertain. The watch will usually be issued 12 to 48 hours in advance of the event.

Wind Chill Warning - GTFWSWTFX: Cold wind chills are forecast or imminent. This product is issued if wind chills are expected to be colder than -40^{o}F with at least 10 mph of wind.

Wind Chill Advisory - GTFWSWTFX: Wind chills are expected to be from -20^{o} to -40^{o}F with at least 10 mph of wind.

Sample Winter Weather Product

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WWUS45 KTFX 061000
WSWTFX
URGENT - WINTER WEATHER MESSAGE
NATIONAL WEATHER SERVICE GREAT FALLS MT
400 AM MDT THU APR 6 2006

MTZ009-012>014-048-050>054-061700-
/O.CON.KTFX.WS.W.0010.000000T0000Z-060407T0000Z/
NORTHERN ROCKY MOUNTAIN FRONT-CASCADE-CHOUTEAU-CENTRAL
AND SOUTHERN LEWIS AND CLARK-SOUTHERN ROCKY MOUNTAIN
FRONT-JUDITH BASIN-FERGUS-JEFFERSON-BROADWATER-
MEAGHER-
INCLUDING THE CITIES OF...BROWNING...GREAT FALLS...
FORT BENTON... HELENA...CHOTEAU...STANFORD...
LEWISTOWN... BOULDER...TOWNSEND... WHITE SULPHUR
SPRINGS
400 AM MDT THU APR 6 2006

...WINTER STORM WARNING REMAINS IN EFFECT UNTIL 6 PM
MDT THIS AFTERNOON FOR ELEVATIONS ABOVE 5000 FEET...

A WINTER STORM WARNING REMAINS IN EFFECT UNTIL 6 PM
MDT THIS AFTERNOON.

WIDESPREAD SNOW WILL CONTINUE AT ELEVATIONS ABOVE 5000
FEET TODAY. BY THIS EVENING...TOTAL SNOWFALL
ACCUMULATIONS OF 1 TO 3 FEET CAN BE EXPECTED FOR
ELEVATIONS ABOVE 5000 FEET ALONG THE ROCKY MOUNTAIN
FRONT...AND IN THE MOUNTAIN RANGES BETWEEN GREAT FALLS
AND LEWISTOWN. SNOWFALL RATES UP TO 3 INCHES PER HOUR
ARE POSSIBLE IN THE MOUNTAINS THROUGH NOON.

A WINTER STORM WARNING MEANS SIGNIFICANT AMOUNTS OF
SNOW ARE EXPECTED OR OCCURRING. THIS WILL MAKE TRAVEL
VERY HAZARDOUS OR IMPOSSIBLE.

LISTEN TO NOAA WEATHER RADIO...OR YOUR LOCAL MEDIA FOR
THE LATEST UPDATES ON THIS SITUATION.

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Non-Precipitation Events

Objectives of the Non-Precipitation Program

Non-precipitation phenomena such as high wind, heat, fog, and freezing temperatures can also pose a threat to public safety. Like winter weather events, non-precipitation events often cover large geographic areas. The Great Falls WFO issues non-precipitation weather products titled "WEATHER MESSAGE" under the header GTFNPWTFX.

The Great Falls WFO issues non-precipitation weather products in the same format described in the winter weather section. An NPW is used to:

- Issue the initial non-precipitation warning or advisory
- Change the type of warning or advisory
- Add or delete zones contained in the warning or advisory
- Change the expiration time of the warning or advisory
- Update information regarding the warning or advisory
- Cancel a non-precipitation weather warning or advisory

An NPW is issued for the following phenomena: High Wind Watch, High Wind Warning, Dense Fog and Blowing Dust. The warnings and advisories are issued in accordance with the following criteria:

High Wind Watch - GTFNPWTFX: Issued when wind is expected to meet or exceed high wind warning criteria 12 to 24 hours in the future.

High Wind Warning - GTFNPWTFX: Issued when sustained winds of ≥40 mph are expected for 1 hour or more or when gusts ≥58 mph are expected for any duration.

Dense Fog Advisory - GTFNPWTFX: Issued when fog reduces visibility to 1/4 mile or less

Blowing Dust Advisory - GTFNPWTFX: Issued when blowing dust reduces visibility to 1/4 mile or less.

Sample Non-Precipitation Product

```
WWUS75 KTFX 060945
NPWTFX
URGENT - WEATHER MESSAGE
NATIONAL WEATHER SERVICE GREAT FALLS MT
345 AM MDT THU APR 6 2006

MTZ009-062200-
/O.CON.KTFX.HW.Y.0015.000000T0000Z-060407T0300Z/
NORTHERN ROCKY MOUNTAIN FRONT-
INCLUDING THE CITIES OF...BROWNING
345 AM MDT THU APR 6 2006

...HIGH WIND WARNING REMAINS IN EFFECT UNTIL 9 PM MDT
THIS EVENING FOR THE NORTHERN ROCKY MOUNTAIN FRONT...

A HIGH WIND WARNING REMAINS IN EFFECT UNTIL 9 PM MDT
THIS EVENING.

A STRONG WESTERLY FLOW WILL CONTINUE TO PRODUCE WIND
GUSTS OVER 60 MPH THROUGH THIS EVENING. WINDS WILL
DIMINISH TO 15 TO 25 MPH WITH GUSTS TO 45 MPH LATER
THIS EVENING. TRAVELERS ON HIGHWAY 2 AND OTHER
INTERESTS IN THE BROWNING...BABB...EAST GLACIER AREAS
SHOULD DELAY TRAVEL OR TAKE EXTRA PRECAUTIONS DURING
THESE HIGH WINDS.

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Fire Weather

Objectives of the Fire Weather Program

The Great Falls Weather Office provides a user-oriented fire weather forecasting service tailored for use by federal, state, and county land and fire management agencies as well as state and county emergency management organizations within our forecast area. The types of forecasts prepared by the Great Falls WFO include general fire weather forecasts, fire-specific forecasts (spot weather forecasts), fire weather watches, and red flag warnings.

The Great Falls WFO issues Fire Weather forecasts for seven zones across north central and southwest Montana (Figure 2.) The Billings and Missoula Weather Forecast Offices issue fire weather products for portions of the Great Falls public zone area over southwest Montana.

The general fire weather forecasts are issued routinely by the Great Falls Office from April through October of each year. This time period is commonly considered to be "fire weather season" in Montana. Fire weather watches and red flag warnings can be issued any time of the year, but occur predominantly during the fire weather season, as well. Spot weather forecasts for wildfires and prescribed burns are issued only upon request. Requests for spot weather forecasts for prescribed burns are accepted from government agencies only.

The Fire Weather Program Leader at Great Falls is a fully trained meteorologist who has received extensive additional training in fire behavior and fire weather forecasting. However, all meteorologists in the Great Falls Office have been trained in performing the office's fire weather forecasting duties.

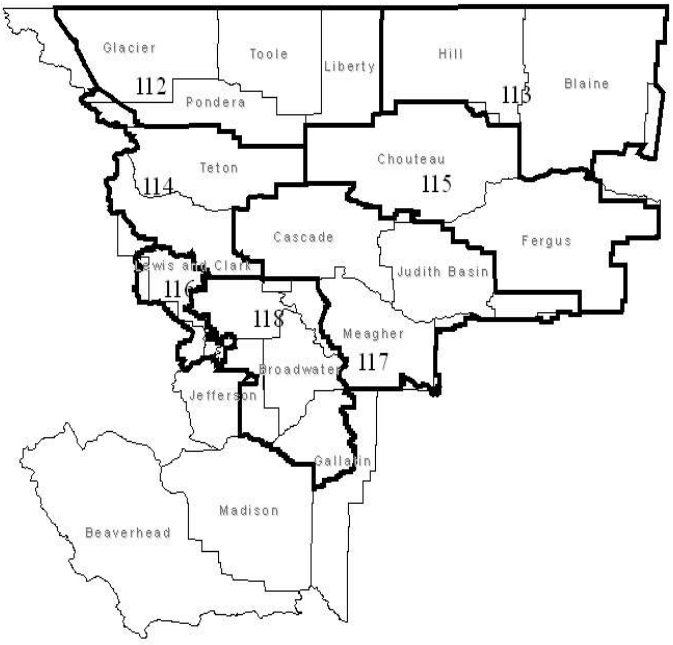

Fig 2. Great Falls Fire Weather Zones

Types of Fire Weather Products

Red Flag Warning - GTFRFWTFX: Issued as needed. A Red Flag Warning is a non-routine, special forecast alerting fire managers of critical or rapidly changing weather conditions that will increase the fire danger in a significant way.

A Red Flag Warning normally requires the combination of "High" or "Extreme" fire danger (as determined by the land management agencies) and critical weather conditions (as determined by the meteorologist). These critical weather conditions include, but are not limited to,

- Thunderstorms producing frequent lightning but little rain ("dry" thunderstorms)
- The first occurrence of lightning after a hot and dry spell,
- A significant increase in wind speed and/or air temperature,
- A significant decrease in relative humidity.

In short, a Red Flag Warning covers any combination of weather and fire danger that, together, would create a critical fire control situation or extensive wildfire occurrences!

Fire Weather Watch - GTFRFWTFX: Issued as needed. This is a special product that alerts users to the possibility that red flag criteria, and therefore a red flag warning, may develop within the next 12 to 48 hours.

General Fire Weather Forecast - GTFFWFTFX: Issued twice daily between 6 a.m. and 8 a.m. and again between 2 p.m. and 3 p.m. This is a forecast of average conditions over a forecast zone (see Figure 2 for the forecast zones). The forecast includes sky/weather, air temperature, relative humidity, wind direction and speed. Also included is a general weather discussion and extended forecast.

Spot Weather Forecast: Issued by request. This is a detailed 24-hour forecast for a specific burn site that helps fire managers and firefighters plan for and predict fire behavior.

Some Common Fire Weather Terms

Clearing Index: An index that relates atmospheric stability and wind to the air pollution potential of an area. Lower values indicate a greater potential for air stagnation and air pollution problems.

Diurnal: Daily. Actions which are completed within 24 hours and which recur every 24 hours.

Downslope/Downvalley: Moving from a higher elevation to a lower elevation.

Dry Thunderstorm: A thunderstorm that produces less than 0.10 inch of precipitation.

Haines Index: An index from 2 (lowest) to 6 (greatest) that relates atmospheric stability and moisture content of the lower atmosphere to the potential for large plume dominated fires.

LAL (Lightning Activity Level): A rating from 1 (lowest) to 6 (greatest) related to the frequency of cloud-to-ground lightning strikes in a 2500 sq. mile area (50 miles x 50 miles).

Mixing Height : The maximum height above the ground surface to which smoke will rise. The air is considered thoroughly mixed up to the mixing height.

Red Flag Criteria: A combination of “High” or “Extreme” fire danger and critical weather conditions that could cause extensive wildfire occurrences or create a critical fire control situation.

Transport Wind: The average wind direction and wind speed between the surface and the mixing height (the mixed layer).

Upslope/Upvalley: Moving from a lower elevation to a higher elevation.

Aviation

Objectives of the Aviation Program

The Great Falls WFO provides terminal area forecasts and enroute aviation weather forecasts for several locations across southwest and north central Montana. The terminal area forecasts are issued 4 times daily throughout the year. Conditions forecast include ceilings, visibility, weather and winds that will affect the airport terminal. Weather enroute forecasts are issued for several routes in the area too. These are route forecasts of weather, ceilings and restrictions to visibility. These are also issued 4 times daily, along with an aviation weather synopsis for Montana.

Types of Aviation Forecasts

Terminal Area Forecast - TAF: Terminal Aerodrome Forecasts (TAFs) are issued by the Great Falls WFO for Bozeman, Cut Bank, Great Falls, Havre, Helena, and Lewistown. These include forecasts of ceilings, restrictions to visibility, weather and winds. These are issued 4 times daily near 00Z, 06Z, 12Z and 18Z (see Figure 3).

Weather Enroute Forecast - TWB: Transcribed Weather Enroute Forecasts (TWBs) are issued by the Great Falls WFO for the following routes (see Figure 3):

Great Falls-Helena-Butte-Idaho Falls,
Great Falls-Cut Bank-Kalispell, and
Great Falls-Missoula.

An area synopsis is also issued at the same time of the TWB issuance. The synopsis summarizes the upper air flow, surface patterns, precipitation distribution and air mass stability. A forecast of patterns is also included. These are issued 4 times daily near 02Z, 08Z, 14Z and 20Z.

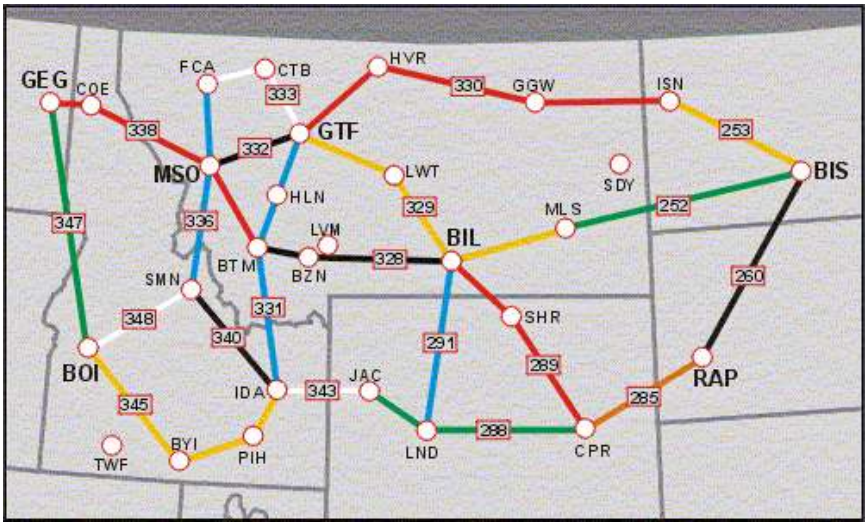

Figure 3. TAF sites and TWB Routes across Montana.

NOAA Weather Radio

Objectives of the NOAA Weather Radio All Hazards Program

NOAA Weather Radio All Hazards (NWR), the voice of the National Weather Service, is a service of the National Oceanic and Atmospheric Administration (NOAA), broadcasting on one of seven VHF Band frequencies ranging from 162.400 MHz to 162.550 MHz. These frequencies are outside the normal AM and FM broadcast bands and require special weather radio receivers for reception of broadcasts, which are available at most retail stores that sell radios.

Employing both human and synthesized voices, the National Weather Service office in Great Falls broadcasts continuous up-to-date weather information from nine weather radio programs:

NWR Locations, Frequencies and Service Areas

Location	Call Sign	Frequency	Serving these Counties
Bozeman	KGG-97	162.500 MHz	Gallatin
Browning	WNG-533	162.525 MHz	Glacier
Butte	WXL-79	162.550 MHz	Beaverhead, Gallatin, Jefferson, Madison
Conrad	WWG-84	162.500 MHz	Choteau, Glacier, Liberty, Pondera, Teton, Toole
Dillon	WNG-638	162.475 MHz	Beaverhead
Great Falls	WXJ-43	162.550 MHz	Cascade, Choteau, Judith Basin, Teton
Havre	WXL-53	162.400 MHz	Blaine, Choteau, Hill
Helena	WXK-66	162.400 MHz	Broadwater, Jefferson, Lewis and Clark, Meagher, Powell
Lewistown	KZZ-54	162.500 MHz	Fergus, Judith Basin

These weather radio transmitters complement a network of more than 900 weather radio transmitters across the nation, currently reaching approximately 90 percent of the U.S. population.

A little known fact about NOAA Weather Radio is that, in addition to providing continuous weather information and warnings, it is designated as the sole government-operated radio system in providing direct warnings into private homes for both natural disasters and nuclear attack. This concept has been expanded to include warnings for all hazardous conditions that pose a threat to life and safety, both at a local and national level. However, most of these non-weather warnings are broadcast if an official letter of agreement exists between the National Weather Service and other agencies.

Programming Schedule

The programming schedule consists of continuous recordings and are routinely revised and updated to keep north central and southwest Montana listeners informed of the latest weather information affecting the region. The entire broadcast cycle typically runs from 4 to 6 minutes in length, but may vary as conditions warrant. Routine products broadcast on the radios include, but are not limited to:

Regional Weather Synopsis: A brief overview, in layman's terms, of the synoptic weather patterns affecting, or expected to affect north central and southwest Montana within the 2-day forecast period. Updates twice a day or as needed.

Recreational/Mountain Forecast: A 7-day product targeted to outdoor recreation. Currently, recreational forecasts include mountainous areas near each transmitter.

Local Forecasts: A 3-day forecast for the lower elevations. These forecasts are updated twice each day and additionally as needed.

Extended Forecast:: A 4 to 7 day forecast for lower elevations near each transmitter.

Current Regional Weather Conditions: Updated hourly, this product gives the complete local hourly weather observations, as well as a collection of 8-15 selected locations across Montana, Idaho, Wyoming, and southern Canada.

Climate Summaries: Once daily summaries of the previous day's weather.

Short-term Forecasts: A service area forecast for the next 3 to 6 hour period that incorporates Doppler radar, satellite and automated/manned surface observations, among other tools, to provide a short-range, but specific outlook.

Other products: Products that are broadcast as needed include Weather Warnings and Watches, Special Weather Statements, Hazardous Weather Outlooks, Public Information Statements, Fire Danger Statements and regional maximum/minimum temperatures. Also, educational/promotional recordings of interest to the general public are broadcast occasionally.

When severe weather threatens a location within the County Warning Area, the routine programming will be interrupted in order to activate the warning alarm. This alarm triggers specially-built weather radios to sound, letting the listener know that important live weather information will be broadcast shortly. Tests of this warning alarm feature are normally conducted every Wednesday, between the hours of 11 am and noon.

Weather Terminology and Definitions

ACCAS (usually pronounced ACK-kis) - AltoCumulus CAStellanus; mid-level clouds (bases generally 8 to 15 thousand feet), of which at least a fraction of their upper parts show cumulus-type development. These clouds often are taller than they are wide, giving them a turret-shaped appearance. ACCAS clouds are a sign of instability aloft, and may precede the rapid development of thunderstorms.

Advection - Transport of an atmospheric property by the wind. See cold advection, moisture advection, warm advection.

Anticyclonic Rotation - Rotation in the opposite sense as the Earth's rotation, i.e., clockwise in the Northern Hemisphere as would be seen from above. The opposite of cyclonic rotation.

Anvil - The flat, spreading top of a Cb (cumulonimbus), often shaped like an anvil. Thunderstorm anvils may spread hundreds of miles downwind from the thunderstorm itself, and sometimes may spread upwind (see back-sheared anvil).

Approaching (severe levels) - A thunderstorm which contains wind of 35 to 49 knots (40 to 57 mph), or hail 1/2 inch or larger but less than 3/4 inch in diameter. See severe thunderstorm.

Backing Wind - Wind which shift in a counterclockwise direction with time at a given location (e.g. from southerly to southeasterly), or change direction in a counterclockwise sense with height (e.g. westerly at the surface but becoming more southerly aloft). The opposite of veering wind.

Bow Echo - A radar echo which is linear but bent outward in a bow shape. Damaging straight-line wind often occur near the "crest" or center of a bow echo.

Box (or Watch Box) - Slang for a severe thunderstorm or tornado watch.

CA - Cloud-to-Air lightning.

CAPE - Convective Available Potential Energy. A measure of the amount of energy available for convection. CAPE is directly related to the maximum potential vertical speed within an updraft; thus, higher values indicate greater potential for severe weather. Observed values in thunderstorm environments often may exceed 1,000 joules per kilogram (j/kg), and in extreme cases may exceed 5,000 j/kg. However, as with other indices or indicators, there are no threshold values above which severe weather becomes imminent.

Cb - Cumulonimbus cloud, characterized by strong vertical development in the form of mountains or huge towers topped at least partially by a smooth, flat, often fibrous anvil. Also known as a "thunderhead."

CC - Cloud-to-Cloud lightning.

Cell - Convection in the form of a single updraft, downdraft, or updraft/downdraft couplet, typically seen as a vertical dome or tower as in a cumulus or towering cumulus cloud. The term "cell" also is used to describe the radar echo returned by an individual shower or thunderstorm. Such usage, although common, is technically incorrect.

CG - Cloud-to-Ground lightning flash.

Chaff - Small strips of metal foil, usually dropped in large quantities from aircraft or balloons. Chaff typically produces a radar echo which closely resembles precipitation. Chaff drops once were conducted by the military in order to confuse enemy radar, but now are conducted mainly for radar testing and calibration purposes.

Cirrus - High-level clouds (16,000 feet or more), composed of ice crystals and appearing in the form of white, delicate filaments or white or mostly white patches or narrow bands. Cirrus clouds typically have a fibrous or hairlike appearance, and often are semi-transparent.

Closed Low - A low pressure area with a distinct center of cyclonic circulation which can be completely encircled by one or more isobars or height contour lines. The term usually is used to distinguish a low pressure area aloft from a low-pressure trough. Closed lows aloft typically are partially or completely detached from the main westerly current, and thus move relatively slowly (see cutoff low).

Cold Advection - Transport of cold air into a region by horizontal wind.

Cold Pool - A region of relatively cold air, represented on a weather map analysis as a relative minimum in temperature surrounded by closed isotherms. Cold pools aloft represent regions of relatively low stability, while surface-based cold pools are regions of relatively stable air.

Comma Cloud - A synoptic scale cloud pattern with a characteristic comma-like shape, often seen on satellite photographs associated with large and intense low-pressure systems.

Confluence - A pattern of wind flow in which air flows inward toward an axis oriented parallel to the general direction of flow. It is the opposite of difluence. Confluence is not the same as convergence. Wind often accelerate as they enter a confluent zone, resulting in speed divergence which offsets the (apparent) converging effect of the confluent flow.

Convection - Generally, transport of heat and moisture by the movement of a fluid. In meteorology, the term is used specifically to describe vertical transport of heat and moisture, especially by updrafts and downdrafts in an unstable atmosphere.. Cbs, towering cumulus clouds, and ACCAS clouds all are visible forms of convection. However, convection is not always made visible by clouds.

Convergence - A contraction of a vector field; the opposite of divergence. Convergence in a horizontal wind field indicates that more air is entering a given area than is leaving at that level. To compensate for the resulting "excess," vertical motion may result: upward forcing if convergence is at low levels, or downward forcing (subsidence) if convergence is at high levels. Upward forcing from low-level convergence increases the potential for storm development (when other factors, such as instability, are favorable). Compare with confluence.

Cumulus - Detached clouds, generally dense and with sharp outlines, showing vertical development in the form of domes, mounds, or towers. Tops normally are rounded while bases are more horizontal. See Cb, towering cumulus.

Cutoff Low - A closed low which has become completely displaced (cut off) from basic westerly current, and moves independently of that current. Cutoff lows may remain nearly stationary for days, or on occasion may move westward opposite to the prevailing flow aloft (i.e., retrogression). "Cutoff low" and "closed low" often are used interchangeably to describe low pressure centers aloft. However, not all closed lows are completely removed from the influence of the basic westerlies.

Cyclogenesis - Development or intensification of a low-pressure center (cyclone).

Cyclonic Circulation (or Cyclonic Rotation) - Circulation (or rotation) which is in the same sense as the Earth's rotation, i.e., counterclockwise (in the Northern Hemisphere) as would be seen from above. Compare with anticyclonic rotation.

Dew Point (or Dew-point Temperature) - A measure of atmospheric moisture. It is the temperature to which air must be cooled in order to reach saturation (assuming air pressure and moisture content are constant).

Difluence (or Diffluence) - A pattern of wind flow in which air moves outward (in a "fan-out" pattern) away from a central axis that is oriented parallel to the general direction of the flow. It is the opposite of confluence. Difluence in an upper level wind field is considered a favorable condition for storm development (if other parameters are also favorable). Difluence is not the same as divergence.

Diurnal - Daily; related to actions which are completed in the course of a calendar day, and which typically recur every calendar day (e.g., diurnal temperature rises during the day, and diurnal falls at night).

Divergence - The expansion or spreading out of a vector field; usually said of horizontal wind. It is the opposite of convergence. Divergence at upper levels of the atmosphere enhances upward motion, and hence the potential for storm development (if other factors also are favorable).

Doppler Radar - Radar that can measure radial velocity, the instantaneous component of motion parallel to the radar beam (i.e., toward or away from the radar antenna).

Downburst - A strong downdraft resulting in an outward burst of damaging wind on or near the ground. Downburst wind can produce damage similar to a strong tornado. Although usually associated with thunderstorms, downbursts can occur with showers too weak to produce thunder. See dry and wet microburst.

Downdraft - A small-scale column of air that rapidly sinks toward the ground, usually accompanied by precipitation as in a shower or thunderstorm. A downburst is the result of a strong downdraft.

Downstream - In the same direction as a stream or other flow, or toward the direction in which the flow is moving.

Dry Microburst - A microburst with little or no precipitation reaching the ground; most common in semi-arid regions. They may or may not produce lightning. Dry microbursts may develop in an otherwise fair-weather pattern; visible signs may include a cumulus cloud or small Cb with a high base and high-level virga, or perhaps only an orphan anvil from a dying rain shower. At the ground, the only visible sign might be a dust plume or a ring of blowing dust beneath a local area of virga. Compare with wet microburst.

Dry Slot - A zone of dry (and relatively cloud-free) air which wraps east- or northeastward into the southern and eastern parts of a synoptic scale or mesoscale low pressure system. A dry slot generally is seen best on satellite photographs.

Dust Devil - A small atmospheric vortex not associated with a thunderstorm, which is made visible by a rotating cloud of dust or debris (dust whirl). Dust devils form in response to surface heating during fair, hot weather; they are most frequent in arid or semi-arid regions.

Dynamics - Generally, any forces that produce motion or affect change. In operational meteorology, dynamics usually refer specifically to those forces that produce vertical motion in the atmosphere.

ECMWF - European Center for Medium-Range Weather Forecasting. Operational references in forecast discussions typically refer to the ECMWF's medium-range forecast model. See MRF, UKMET.

Enhanced Fujita Scale - A scale of wind damage intensity in which wind speeds are inferred from an analysis of wind damage. All tornadoes, and most other severe local windstorms, are assigned a single number from this scale according to the most intense damage caused by the storm. The Enhanced Fujita incorporated 28 damage indicators and the degree of damage.

EF0 (weak): 65 - 85mph
EF1 (weak): 86 - 110 mph
EF2 (strong): 111 - 135 mph
EF3 (strong): 136 - 165 mph
EF4 (violent): 166 - 200 mph
EF5 (violent): Over 200 mph

Entrance Region - The region upstream from a wind speed maximum in a jet stream (jet max), in which air is approaching (entering) the region of maximum wind, and therefore is accelerating. This acceleration results in a vertical circulation that creates divergence in the upper-level wind in the right half of the entrance region (as would be viewed looking along the direction of flow). This divergence results in upward motion of air in the right rear quadrant (or right entrance region) of the jet max. Severe weather potential sometimes increases in this area as a result. See also exit region, left exit region.

Exit Region - The region downstream from a wind speed maximum in a jet stream (jet max), in which air is moving away from the region of maximum wind, and therefore is decelerating. This deceleration results in divergence in the upper-level wind in the left half of the exit region (as would be viewed looking along the direction of flow). This divergence results in upward motion of air in the left front quadrant (or left exit region) of the jet max. Severe weather potential sometimes increases in this area as a result. See also entrance region, right entrance region.

F scale - See Enhanced Fujita Scale.

Front - A boundary or transition zone between two air masses of different density, and thus (usually) of different temperature. A moving front is named according to the advancing air mass, e.g., cold front if colder air is advancing.

Fujita Scale- See Enhanced Fujita Scale

Funnel Cloud - A condensation funnel extending from the base of a towering cumulus or Cb, associated with a rotating column of air that *is not in contact with the ground* (and hence different from a tornado).

Gust Front - The leading edge of gusty surface wind from thunderstorm downdrafts; sometimes associated with a shelf cloud or roll cloud.

Humidity - Generally, a measure of the water vapor content of the air. Popularly, it is used synonymously with relative humidity.

Impulse - See upper level system.

Instability - The tendency for air parcels to accelerate when they are displaced from their original position; especially, the tendency to accelerate upward after being lifted.

Inversion - Generally, a departure from the usual increase or decrease in an atmospheric property with altitude. Specifically it almost always refers to a temperature inversion, i.e., an increase in temperature with height, or to the layer within which such an increase occurs.

Jet Max (or Speed Max, Jet Streak) - a point or area of relative maximum wind speeds within a jet stream.

Jet Stream - Relatively strong wind concentrated in a narrow stream in the atmosphere, normally referring to horizontal, high-altitude wind. The position and orientation of jet streams vary from day to day. General weather patterns (hot/cold, wet/dry) are related closely to the position, strength and orientation of the jet stream (or jet streams). A jet stream at low levels is known as a low-level jet.

Lapse Rate - The rate of change of an atmospheric variable, usually temperature, with height. A steep lapse rate implies a rapid decrease in temperature with height (a sign of instability) and a steepening lapse rate implies that destabilization is occurring.

Left Front Quadrant (or Left Exit Region) - The area downstream from and to the left of an upper-level jet max (as would be viewed looking along the direction of flow). Upward motion and severe thunderstorm potential sometimes are increased in this area relative to the wind speed maximum. See also entrance region, right rear quadrant.

Lifted Index (or LI) - A common measure of atmospheric instability. Its value is obtained by computing the temperature that air near the ground would have if it were lifted to some higher level (around 18,000 feet, usually) and comparing that temperature to the actual temperature at that level. Negative values indicate instability - the more negative, the more unstable the air. There are no "magic numbers" or threshold LI values below which severe weather becomes imminent.

Longwave Trough - A trough in the prevailing westerly flow aloft which is characterized by large length and (usually) long duration. Generally, there are no more than about five longwave troughs around the Northern Hemisphere at any given time. Their position and intensity govern general weather patterns (e.g., hot/cold, wet/dry) over periods of days, weeks, or months. Smaller disturbances (e.g., shortwave troughs) typically move more rapidly through the broader flow of a longwave trough, producing weather changes over shorter time periods (a day or less).

Mammatus Clouds - Rounded, smooth, sack-like protrusions hanging from the underside of a cloud (usually a thunderstorm anvil). Mammatus clouds often accompany severe thunderstorms, but do not produce severe weather; they may accompany non-severe storms as well.

Medium Range - In forecasting, (generally) three to seven days in advance.

Meridional Flow - Large-scale atmospheric flow in which the north-south component (i.e., longitudinal, or along a meridian) is pronounced. The accompanying zonal (east-west) component often is weaker than normal. Compare with zonal flow.

Mesonet - A regional network of observing stations (usually surface stations) designed to diagnose mesoscale weather features and their associated processes.

Microburst - A small, concentrated downburst affecting an area less than 4 kilometers (about 2.5 miles) across. Most microbursts are rather short-lived (5 minutes or so), but on rare occasions they have been known to last up to 6 times that long.

Moisture Advection - Transport of moisture by horizontal wind.

NAM Model - North American Model. One of the operational numerical forecast models run at NCEP. The NAM is run twice daily, with forecast output out to 48 hours. This model will be replaced by the Weather Research Model (WRF) in June 2006.

NCEP - National Centers for Environmental Prediction.

Negative-tilt Trough - An upper level system which is tilted to the west with increasing latitude (i.e., with an axis from southeast to northwest). A negative-tilt trough often is a sign of a developing or intensifying system.

NEXRAD - NEXt-Generation Weather RADar. Technologically-advanced weather radar being deployed to replace WSR-57 and WSR-74 units. NEXRAD is a high-resolution Doppler radar with increased emphasis on automation, including use of algorithms and automated volume scans. NEXRAD units are known as WSR-88D.

NGM - Nested Grid Model; one of the operational forecast models run at NCEP. The NGM is run twice daily, with forecast output out to 48 hours.

Nocturnal - Related to nighttime, or occurring at night.

Nowcast - A short-term weather forecast, generally out to six hours or less.

Orographic Lift - Lifting of air caused by its passage up and over mountains or other sloping terrain.

Overrunning - A weather pattern in which a relatively warm air mass is in motion above another air mass of greater density at the surface. Overrunning often is applied to the case of warm air riding up over a retreating layer of colder air, as along the sloping surface of a warm front. Such use of the term technically is incorrect, but in general it refers to a pattern characterized by widespread clouds and steady precipitation on the cool side of a front or other boundary.

Positive-tilt Trough - An upper level system which is tilted to the east with increasing latitude (i.e., from southwest to northeast). A positive-tilt trough often is a sign of a weakening weather system.

PVA - Positive Vorticity Advection. Advection of higher values of vorticity into an area, which often is associated with lifting of the air. PVA typically is found in advance of disturbances aloft (i.e., shortwaves).

Reflectivity - Radar term referring to the ability of a radar target to return energy; used to derive echo intensity, and to estimate precipitation intensity and rainfall rates.

Relative Humidity - A dimensionless ratio, expressed in percent, of the amount of atmospheric moisture present relative to the amount that would be present if the air were saturated. Since the latter amount is dependent on temperature, relative humidity is a function of both moisture content and temperature. As such, relative humidity by itself does not directly indicate the actual amount of atmospheric moisture present. See dew point.

Retrogression (or Retrograde Motion) - Movement of a weather system in a direction opposite to that of the basic flow in which it is embedded, usually referring to a closed low or a longwave trough which moves westward.

Right Entrance Region (or Right Rear Quadrant) - The area upstream from and to the right of an upper-level jet max (as would be viewed looking along the direction of flow). Upward motion and storm potential sometimes are increased in this area relative to the wind speed maximum. See also exit region, left front quadrant.

Ridge - An elongated area of relatively high atmospheric pressure; the opposite of trough.

RUC - Rapid Update Cycle, a numerical model run at NCEP that focuses on short-term (up to 12 h) forecasts and small-scale (mesoscale) weather features. Forecasts are prepared every 3 hours for the contiguous United States.

Scud (or Fractus) - Small, ragged, low cloud fragments that are unattached to a larger cloud base and often seen with and behind cold fronts and thunderstorm gust fronts. Such clouds generally are associated with cool moist air.

Severe Thunderstorm - A thunderstorm which produces tornadoes, hail 0.75 inches or more in diameter, or wind of 50 knots (58 mph) or more. Structural wind damage may imply the occurrence of a severe thunderstorm. See approaching (severe).

Shear - Variation in wind speed (speed shear) and/or direction (directional shear) over a short distance. Shear usually refers to vertical wind shear, i.e., the change in wind with height.

Shortwave (or Shortwave Trough) - A disturbance in the mid or upper part of the atmosphere which induces upward motion ahead of it. If other conditions are favorable, the upward motion can contribute to storm development ahead of a shortwave.

Sounding - A plot of the vertical profile of temperature and dew point (and often wind) above a fixed location. Soundings are used extensively in weather forecasting, e.g., to determine instability, locate temperature inversions, measure the strength of the cap, obtain the convective temperature, etc.

Squall Line - A solid or nearly solid line or band of active thunderstorms.

Straight-line Wind - Generally, any wind that is not associated with rotation, used mainly to differentiate them from tornadic wind.

Stratiform - Having extensive horizontal development, as opposed to the more vertical development characteristic of convection. Stratiform clouds cover large areas but show relatively little vertical development. Stratiform precipitation, in general, is relatively continuous and uniform in intensity (i.e., steady rain versus rain showers).

Stratocumulus - Low-level clouds, existing in a relatively flat layer but having individual elements. Elements often are arranged in rows, bands, or waves. Stratocumulus often reveals the depth of the moist air at low levels, while the speed of the cloud elements can reveal the strength of the low-level jet.

Stratus - A low, generally gray cloud layer with a fairly uniform base. Stratus may appear in the form of ragged patches, but otherwise does not exhibit individual cloud elements as do cumulus and stratocumulus clouds. Fog usually is a surface-based form of stratus.

Subsidence - Sinking (downward) motion in the atmosphere, usually over a broad area.

Synoptic Scale (or Large Scale) - Size scale referring generally to weather systems with horizontal dimensions of several hundred miles or more. Most high and low pressure areas seen on weather maps are synoptic-scale systems. Compare with mesoscale, storm-scale.

Tornado - A violently rotating column of air extending from the base of a thunderstorm and *in contact with the ground* . A condensation funnel does not need to reach to the ground for a tornado to be present; a debris cloud beneath a thunderstorm is all that is needed to confirm the presence of a tornado, even in the total absence of a condensation funnel.

Towering Cumulus - (Same as congestus.) A large cumulus cloud with great vertical development, usually with a cauliflower-like appearance, but lacking the characteristic anvil of a Cb. (Often shortened to "towering cu," and abbreviated TCU.)

Trough - An elongated area of relatively low atmospheric pressure, usually not associated with a closed circulation, and thus used to distinguish from a closed low. The opposite of ridge.

Updraft - A small-scale current of rising air.

Upper Level System - A general term for any large-scale or mesoscale disturbance capable of producing upward motion (lift) in the middle or upper parts of the atmosphere. This term sometimes is used interchangeably with impulse or shortwave.

Upslope Flow - Air that flows toward higher terrain, and hence is forced to rise. The added lift often results in widespread low cloudiness and stratiform precipitation if the air is stable, or an increased chance of storm development if the air is unstable.

Upstream - Toward the source of the flow, or located in the area from which the flow is coming.

UVV - Upward Vertical Velocity.

VAD Wind Profile. Velocity Azimuth Display. A radar plot of horizontal wind, derived from VAD data, as a function of height above a Doppler Radar. The display is plotted with height as the vertical axis and time as the horizontal axis (a so-called time-height display), which then depicts the change in wind with time at various heights. This display is useful for observing local changes in vertical wind shear, such as backing of low-level wind, increases in speed shear, and development or evolution of nearby jet streams (including low-level jets).

Veering Wind - Wind which shift in a clockwise direction with time at a given location (e.g., from southerly to westerly), or which change direction in a clockwise sense with height (e.g., southeasterly at the surface turning to southwesterly aloft). Compare with backing wind.

Virga - Streaks or wisps of precipitation falling from a cloud but evaporating before reaching the ground. In certain cases, shafts of virga may precede a microburst; see dry microburst.

Vorticity - A measure of the local rotation in a fluid flow. In weather analysis and forecasting, it usually refers to the vertical component of rotation (i.e., rotation about a vertical axis) and is used most often in reference to synoptic scale or mesoscale weather systems. By convention, positive values indicate cyclonic rotation.

Vort Max - (Slang; short for vorticity maximum), a center, or maximum, in the vorticity field.

Warm Advection - Transport of warm air into an area by horizontal wind. Low-level warm advection sometimes is referred to (erroneously) as overrunning. Although the two terms are not properly interchangeable, both imply the presence of lifting in low levels.

Warning - A product issued by NWS local offices indicating that a particular weather hazard is either imminent or has been reported. A warning indicates the need to take action to protect life and property. The type of hazard is reflected in the type of warning (e.g., tornado warning, blizzard warning).

Watch - An NWS product indicating that a particular hazard is possible, i.e., that conditions are more favorable than usual for its occurrence. A watch is a recommendation for planning, preparation, and increased awareness (i.e., to be alert for changing weather, listen for further information, and think about what to do if the danger materializes).

Watch Box (or Box) - [Slang], a severe thunderstorm or tornado watch.

Waterspout - In general, a tornado occurring over water. Specifically, it normally refers to a small, relatively weak rotating column of air over water beneath a Cb or towering cumulus cloud. Waterspouts are most common over tropical or subtropical waters. The exact definition of waterspout is debatable. In most cases the term is reserved for small vortices over water that are not associated with storm-scale rotation (i.e., they are the water-based equivalent of landspouts). But there is sufficient justification for calling virtually any rotating column of air a waterspout if it is in contact with a water surface.

Wind Shear - See shear.

WRF Model - Weather Research Model

Zonal Flow - Large-scale atmospheric flow in which the east-west component (i.e., latitudinal) is dominant. The accompanying meridional (north-south) component often is weaker than normal. Compare with meridional flow.

Frequently Used Telephone Numbers & Addresses

National Weather Service
Great Falls WFO
5324 Tri-Hill Frontage Road
Great Falls, MT 59404-4933

Spotter / Emergency Manager Line	406-453-2081
Great Falls area Recorded Forecast	406-453-5469/5460
FAX	406-453-3812
Internet Address	weather.gov/greatfalls

National Climatic Data Center — 828-271-4800
Federal Building — FAX 828-271-4876
151 Patton Ave.
Asheville, NC 28801-5001

Western Regional Climate Center — 775-674-7010
FAX 775-674-7016

Internet Addresses

Internet Weather Links

National Weather Service

Great Falls, MT
weather.gov/greatfalls

National Weather Service Headquarters
http://weather.gov

EMWIN
http://iwin.nws.noaa.gov/emwin/index.htm

Universities

Ohio State University Weather Page
http://twister.sbs.ohio-state.edu/

University Center for Atmospheric Research
http://www.rap.ucar.edu/weather

University of Michigan Weather Page
http://cirrus.sprl.umich.edu/wxnet

University of Utah Weather Page
http://www.met.utah.edu/

El Nino / La Nina Information

NOAA El Nino/La Nina Page
http://www.elnino.noaa.gov/lanina.html

Meteorological Organizations

American Meteorological Society
http://www.ametsoc.org/

National Weather Association
http://www.nwas.org/

Internet Climate and Education Links

Climate Data

National Climatic Data Center
http://www.ncdc.noaa.gov

Colorado Climate Center
http://ulysses.atmos.colostate.edu/

Utah Climate Center
http://climate.usu.edu/

Western Region Climate Center
http://www.wrcc.dri.edu/

High Plains Regional Climate Center
http://www.hprcc.unl.edu/

Climate Prediction Center
http://www.cpc.noaa.gov/

Weather Education

Tornadoes
http://www.nws.noaa.gov/om/tornado.htm

Lightning
http://www.nws.noaa.gov/om/trwbro.htm

Floods/Flash Floods
http://www.nws.noaa.gov/om/ffbro.htm

Winter Storms
http://www.nws.noaa.gov/om/wntrstm.htm

Guide to All Things Weather
http://ww2010.atmos.uiuc.edu/(Gh)/guides

Other Links

Ultimate List of Weather Sites
http://www.met.utah.edu/wx/wx_links.html